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Abstract

FISSION PRODUCT BUILD-UP AND LONG TERM REACTIVITY EFFECTS

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The complex of reactors at the Test Reactor Area (TRA), National Reactor Testing Station in Idaho, provide a unique combination for the measurement of long-term effects in samples irradiated to large nvt values. The Materials Testing Reactor (MTR) and the Engineering Test Reactor (ETR) constitute irradiation facilities in which flux levels approaching 10^{15} and a considerable range of spectra are available, while the Advanced Reactivity Measurement Facilities I and II (ARMF-I and ARMF-II) constitute measuring instruments capable of precision of $\leq \pm 2.0 \times 10^{-7}$ $\Delta k/k$ in reactivity changes. These latter two pool-type reactors are improved versions of the original Reactivity Measurement Facility (RMF) described at the Second International Conference on the Peaceful Uses of Atomic Energy. The application of this type of facility to the subject problems was demonstrated in the 1958 paper. However, the scope has been broadened by the use of two reactors having similar operating characteristics, with different responses to thermal and resonance absorbers, but retaining radial symmetry about the sample axis.

These reactors have been used to study the effects of long-term irradiations, in a variety of spectra and at various neutron flux levels, on fissile, fertile, and neutron absorbing materials. These studies, using small samples, have been aimed at determining how k-infinity, conversion ratio, and the neutron absorption properties of control materials vary as a function of the length of operation of various full scale power reactors, in the thermal and near thermal neutron energy range. Measurements of fissile materials include the irradiation of:

a) test fuel plates directed toward the study of compositions and fabrication methods, b) special samples for the measurement of I-135 yields in fission, c) gross fission product poison studies, and d) specific examples of proposed reactor core cell configurations. The fertile material studies include the U-238-Pu-239 and Th-232-U-233 irradiation chains, and the isotopic distribution of the products. The third area includes studies on the irradiation of such multiple-isotope poisons as dysprosium, hafnium, and europium.

Each of these studies, because of conditions peculiar to their nature, requires a variety of considerations dealing with sample design, methods of transfer between irradiation and measurement facility, heat transfer, and data interpretation. The paper includes a progress report on investigations now underway.